ENVIRON

December 10, 1998

Brad Bradley
On-Scene Coordinator
United States Environmental Protection Agency
Region 5
77 West Jackson Boulevard
Chicago, IL 60604-3590

Dear Mr. Bradley:

Enclosed is a revised copy of the Risk Management Plan for the Dutch Boy Site. This draft incorporates the comments provided in your letter dated October 19, 1998. The only other substantive change we have made relates to the discussion of the USTs on page 14 of the report, which we have revised to be consistent with the rest of the report.

If you have any questions, please call me.

Sincerely,

Ranjit J. Machado

Ranjit J. Machado, P.E.
Principal

cc: Terry Casey, C.E.P.

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RISK MANAGEMENT PLAN
DUTCH BOY SITE

Prepared for:

NL Industries, Inc.
Chicago, Illinois

Prepared by:

ENVIRON International Corporation
Arlington, Virginia

November 1998

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TABLES

FIGURES

I. EXECUTIVE SUMMARY

The Dutch Boy site (Site) is located in south-central Chicago, Illinois. Historically, the Site was used for lead-related operations that have resulted in lead contamination of surface and subsurface soils. Approximately 75% of the 5-acre Site is paved with reinforced concrete and is underlain by extensive utility infrastructure, for which no records exist.

The USEPA conducted a risk assessment for the Site and developed a cleanup goal of 1,400 mg/kg lead under an industrial future land use scenario. This Risk Management Plan presents and evaluates remedial scenarios to mitigate and manage the risks posed by lead contamination present in Site soils at concentrations above this threshold.

An investigation of the Site was conducted, during which thirty five boreholes were installed in the unpaved areas. Lead was detected in concentrations above the 1,400 mg/kg threshold in most of these boreholes. The depth of contamination exceeding the cleanup level of 1400 ppm extended down to seven feet below ground in some locations. The total volume of soil exceeding the threshold is approximately 5,000 yd^3. Limited lead contamination was encountered under some of the paved sections of the Site. However, the existing pavement prevents access, adequately containing the lead. Thus, remedial options were considered to address exposed soils in the unpaved areas of the Site.

Technologies and remedial scenarios available to mitigate and manage the risks posed by this lead contamination include separation of the lead from the soil matrix, immobilization of the lead within the soil matrix, containment of the soil and lead, and excavation and removal of soil contamination with lead above the cleanup level of 1400 ppm. These technologies were evaluated for protectiveness of human health and the environment and cost effectiveness. In addition, the appropriateness of the technology or remedial strategy for application at the Site was considered and used as a preliminary filter.

The most appropriate technologies were engineering/institutional controls through containment of the Site with a compacted soil cover, stabilization and solidification of the contaminated soil matrix, which immobilizes the lead, and excavation/treatment/disposal off-site. Complete excavation to 1400 ppm lead of the unpaved, contaminated soils and engineering/institutional controls for the paved, contaminated soils were determined to be protective of human health and the environment and achieved ARARs.

Alternatives considered included (1) a soil cover over the unpaved areas of the Site, (2) removal of the top two feet of soil in the principal threat waste area and a soil cover over the unpaved areas, (3) removal of the top two feet of soil in the unpaved areas, and (4) removal of all soil with lead concentrations greater than the 1,400 mg/kg threshold. Table ES-1 presents a summary of the alternatives evaluated; costs for the four alternatives ranged from approximately $750,000 to $1,600,000.

The most protective remedy was determined to be Alternative 4: excavation of all unpaved area soils with lead concentrations greater than 1400 ppm, stabilization/solidification, and disposal off-site. Lead contamination existing under the paved area will be left in place[1]. The contamination of soil in the paved areas will be addressed via repaving/repairing of any cracks on portions of paved areas that do not provide an adequate barrier to direct contact with lead-contaminated soils, and Operation and Maintenance (O&M) of paved areas to ensure the integrity of these areas. If future plans involve removal or penetration of any portion of the paved surfaces, soil with lead levels above 1400 ppm that is generated will be managed properly. The Debris Pile will be removed and properly disposed. The USTs will be closed if required by applicable laws and regulations. This alternative, Alternative 4, is consistent with the provisions of the Administrative Order directing remediation of the Site, is protective of human health and the environment, and meets all ARARs. Although not the lowest cost alternative, it is the most protective in removing contaminated soils and materials from the Site. This alternative is estimated to cost approximately $1,600,000. Table ES-2 provides the design and construction schedule.

[1] Lead concentrations above 1400 ppm in the paved areas were detected as surface contamination (0-2 inches below the paving) in 4 locations and as subsurface contamination (1-2 feet below the paving) in 3 of the remaining 17 locations sampled.

TABLE ES-1
Comparison of Remedial Alternatives

Alternative	Elements [1]	Protectiveness	Cost
1. On-Site Containment	Five feet soil cover over the unpaved areas. Imposes restrictions on intrusive activities.	All exposed contaminated soils covered with several feet of soil preventing direct contact.	$740,000
2. Excavation of Principal Threat Waste, Containment	Excavate top two feet of soil in principal threat waste area, treat and dispose off-Site. Backfill and place five feet of soil cover over the unpaved areas.	As protective as Alternative 1. Removes the highly contaminated waste, thereby preventing exposure to this material should intrusive activity occur.	$940,000
3. Excavation of Two Feet of Contaminated Soil	Excavate two feet of soil, treat and dispose off-Site, backfill to original grade. Imposes restrictions on intrusive activities.	As protective as Alternative 1. Limits residual contamination to a smaller section of the Site.	$1,200,000
4. Excavation of Contaminated Soil	Excavate all soils above the cleanup goal, treat, dispose off-Site, backfill to original grade, imposes restrictions on, and O&M for, paved areas of the Site.	Provides adequate protection of human and the environment, and provides for unrestricted use of the unpaved areas of the Site.	$1,600,000

[1] All alternatives include removal and disposal of the Debris Pile and address the Underground Storage Tanks consistent with the regulations.

TABLE ES-2
Schedule for Remedial Design and Construction

Event/Document	Due Date
60 Percent Design, including draft QAPP, HSP, Cost Estimate, Project Schedule	December 15, 1998
Final Design, including final QAPP, HSP, Cost Estimate, Project Schedule	30 days after receipt of EPA comments on 60 percent design
Begin Construction of Preferred Alternative	April 30, 1999
Complete Construction of Preferred Alternative	Per schedule in approved Final Design

II. INTRODUCTION

A. Background

NL Industries, Inc. (NL) retained ENVIRON International Corporation (ENVIRON) to prepare this Risk Management Plan (Plan) to address the mitigation of risks to human health and the environment at the Dutch Boy Site (Site), Chicago, Illinois. This plan has been prepared in accordance with the March 26, 1996 Unilateral Administrative Order (Order) issued to NL by the U.S. Environmental Protection Agency (USEPA).

Pursuant to the requirements of the Order, ENVIRON prepared the *Final Revised Sampling and Analysis Plan, Dutch Boy Site, Chicago, Illinois,* (SAP) dated December 11, 1996 to guide the investigation of lead contamination in Site soil. Based on the results of this investigation, ENVIRON prepared the *Extent of Contamination Summary, Dutch Boy Site, Chicago, Illinois,* (EOC) dated November 19, 1997. The EOC is summarized in **Section III -- Extent of Contamination,** below.

This plan presents general remedial strategies to manage and mitigate the potential threat to human health and the environment posed by lead contamination in soil at the Site.

B. Site Description and History

The Site is located at 12042 South Peoria Street, Cook County, Chicago, Illinois (Figure 1). The Site consists of a parcel of land approximately 5.2 acres in size, and is surrounded by industrial facilities and warehouses to the north and south, and vacant or abandoned lots to the east and west. No buildings presently exist on-Site, although remnants of heavy machinery and processing equipment likely related to Site operations are present on the property. Approximately 75% of the Site is paved with concrete, 5% with asphalt, and the remaining land is not paved (Figure 2). The unpaved areas appear to be related to former railroad spurs that cross the property, and run in strips from north to south along the western edge of the property and extend to the southeast corner of the Site (Figure 2). Most of the Site is either at ground surface or elevated by approximately four feet to loading dock level. One large pile of debris, consisting of refuse from Site demolition operations, rests in the southwest corner of the Site. The debris pile comprises approximately 800 cubic yards of material. Several underground storage tanks are still present in the western portion of the Site, beneath concrete pads adjoining the northwestern Site boundary and within a loading dock between railroad spurs in the western part of the Site. Site soils comprise approximately two to four feet of artificial fill overlying the native olive green fine sands. A more detailed description of the Site and the surrounding properties is included in the SAP.

Historic land use at the Site has included the manufacture and refinement of white lead (i.e., lead carbonate) and lead oxide for lead-based paints and other lead-related products from 1906 until approximately 1980. According to Sanborn maps and historical aerial photographs, extensive building demolition occurred at the Site in the mid-1980s, with the final demolition of the Mill Building in 1996. Some structures were razed as early as the turn of the century.

Various other industrial activities have been conducted in the immediate vicinity of the Site, including an aluminum foundry, metal machining shops, vehicle and heavy equipment maintenance and storage, junkyards, coal yards, and other metal treatment, forging, finishing, and pickling operations. Sanborn maps, included in the SAP, show the specific locations of these operations. Although most of the properties surrounding the Site are currently abandoned or vacant, it is likely that historical activities at these facilities have influenced lead concentrations in soils in the Site vicinity.

III. EXTENT OF CONTAMINATION

The Extent of Contamination survey for the Dutch Boy Site was prepared in accordance with the March 26, 1996 Unilateral Administrative Order issued by the U.S. EPA to NL Industries, Inc. The primary objective of the EOC survey was to evaluate the vertical and horizontal extent of lead in soil at the Site and in its vicinity. The EOC survey was based on the *Final Revised Sampling and Analysis Plan, Dutch Boy Site, Chicago, Illinois* (ENVIRON December, 1996) (the SAP). In total, more than 350 environmental samples from 151 locations at the Site and its vicinity were collected and analyzed. The EOC report summarizes the results of this sampling and defines contamination likely attributable to historic activities at the Dutch Boy Site. The results of the on-Site soil sampling were compared with an industrial cleanup goal of 1,400 mg/kg lead in soils, established by the USEPA (1996a).

The extent of on-Site soils containing lead at concentrations greater than the 1,400 mg/kg industrial cleanup goal ("the cleanup goal") is generally limited to the western, unpaved portions of the Site. Figure 3 shows the extent of on-Site lead contamination exceeding the cleanup goal. The areas most affected are the former rail spurs leading to the loading dock in the northwestern portion of the Site. Surface soil (i.e., 0.0 - 0.2 feet below ground surface) lead concentrations in this area are in the 5,000-10,000 mg/kg range.

As evident from Figure 3, there are very few locations where soil lead concentrations exceed 1,400 mg/kg in the paved areas of the Site. Elevated areas (e.g., structures such as loading docks and building footprints elevated above ground surface) in the southern and eastern portions of the Site appear to contain clean fill and were not contaminated by Site operations. According to Sanborn Insurance maps from 1911, 1939, and 1973, much of the Site was paved or covered with buildings during most of the operational history of the Site (see Figure 2). Therefore significant lead contamination would not be expected to be present below the concrete. The sampling results summarized in Table 1 show only two locations (SS26 and SS28[2]) in the paved area where lead was present in concentrations substantially above 1,400 mg/kg in subsurface soils. Since contamination beneath the concrete is limited, is not susceptible to migration, and is not accessible, the remainder of this report addresses only lead contamination in the unpaved areas, where lead is accessible so that exposures to lead may occur.

[2]The concrete at SS-26 was approximately one foot thick. The fill material sampled at SS-28 appeared to be sandwiched between two layers of concrete.

Besides lead, analyses for several other parameters (e.g., asbestos, petroleum hydrocarbons, and volatile organic compounds) were conducted on selected samples to evaluate their impact on remedial technologies for the lead-contaminated soil. The investigation results show the presence of diesel-related petroleum hydrocarbons near the loading dock in the northwest portion of the Site (Figure 2). This contamination is confined to soils in the immediate vicinity of the USTs. Based on the level of hydrocarbon contamination detected at the Site, it is unlikely that hydrocarbon contamination will affect any of the technologies that may be used to address lead contamination. Nevertheless, this observation will have to be confirmed once a remedy for the Site is selected.

IV. SITE REMEDIATION CONSIDERATIONS

The USEPA (1996a) calculated a cleanup goal of 1,400 mg/kg for lead in soil taking into consideration future industrial/commercial use of the Site. Precluding contact with soil containing lead above these concentrations protects human health and the environment, under exposure scenarios and working conditions typical of industrial facilities. Accordingly, this Plan focuses on soils that exceed the cleanup goal of 1,400 mg/kg and evaluates remedial alternatives that minimize potential exposure to this material.

A. Volume of Contaminated Soil

The volume of contaminated soil is estimated based on the spatial distribution of soil borings in which lead was detected above 1,400 mg/kg. Lead was detected above the 1,400 mg/kg threshold in most borings in the unpaved areas of the Site (Figure 3). To estimate the area of lead impacts represented by the boreholes, an irregular polygon was constructed around each borehole such that the sides of the polygon are an equal distance away from the borehole and its nearest neighboring boreholes. This procedure (called the method of Thiessen's polygons) assumes that each borehole is equally significant in the sampling strategy. The areas of each of these borehole-centered polygons are presented in Table 2. The depth of contamination provides the final dimension needed for calculating the volume of soil impacted by lead at concentrations greater than 1,400 mg/kg. This volume then represents a column of soil at the Site whose areal footprint is defined by the Thiessen polygon and whose depth is defined by the greatest depth at which lead was detected at concentrations greater than 1,400 mg/kg.

Table 2 presents the total volume of soil with lead concentrations greater than 1,400 mg/kg around each borehole. The volume of affected soils in the 0-2 feet interval is approximately 3,000 cubic yards. An additional 1,500 cubic yards of contaminated soil is present in the subsurface soil in the loading dock area, resulting in a combined estimated volume of approximately 5,000 cubic yards. As shown in Table 2, the lead concentrations in soils within the 0-2 feet interval is generally above 2,000 mg/kg.

B. Principal Threat Wastes

The USEPA has established general expectations in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) for dealing with the threat posed by hazardous substances at a Site. The Preamble to the NCP sets out a program expectation regarding the treatment of principal threats whenever practicable, and defines a principal threat "... as wastes that cannot be reliably controlled in place, such as liquids, highly mobile materials (e.g., solvents), and high concentrations of toxic compounds (e.g., several orders of magnitude above levels that allow for unrestricted use and unlimited exposure)." USEPA has expressed a preference for treatment, wherever practicable, to address principal threat wastes.

Based on the levels of lead at the Site, it is anticipated that approximately 1,000 cubic yards of soil may be characterized as principal threat wastes. USEPA requires that treatment of principal threat wastes be considered, but does not necessarily require that treatment be conducted, depending on site-specific considerations.

C. Remedial Strategies

The fundamental goal of any remedial strategy for the Dutch Boy Site is to mitigate the risk to human health and the environment presented by lead-contaminated soil. The USEPA (1996a) has established a threshold of 1,400 mg/kg lead for defining the lead contamination to be addressed. Section IV.A defined the nature and extent of soils exceeding this threshold. Risk from soils with concentrations of lead greater than this threshold can be mitigated by interrupting the pathway between the source of the risk and any populations at risk or by removing the source of the risk -- the soil. Pathways can be interrupted by physically or chemically immobilizing the lead in the soil matrix or by introducing a physical barrier to the soils, such as a cap or cover. Source removal at this Site would require either excavation of the contaminated soil and disposal in an appropriate facility, or excavation, treatment of soil to remove/immobilize the lead, and replacement of the treated soil on-Site. Given the lead concentrations in soil, some form of treatment would be required prior to off-Site disposal (PDC 1998; Heritage 1998).

Consistent with USEPA's guidance on principal threat and low level threat wastes, a combination of treatment and excavation of principal threat wastes, and engineering controls (such as containment) and/or institutional controls for remaining wastes, is the remedial strategy that is most applicable given conditions at the Dutch Boy Site. Other issues and problems with which a remedial strategy should be consistent are the final disposition of underground storage tanks (USTs) and the Debris Pile (Figure 3).

Remedy evaluation in this report will qualitatively acknowledge the degree to which usable infrastructure, such as paved areas and loading docks, is preserved for future developers. Restrictions on future development and land use that might result from a particular type of remedial risk management strategy will also be considered, as appropriate.

V. TECHNOLOGY SCREENING

The risk from exposure to lead can be mitigated by a combination of containment and treatment of lead-contaminated soil, or essentially eliminated via excavation and disposal of lead-contaminated soils. Containment remedies rely on reducing access to contamination to mitigate exposure. Treatment focuses on reducing the mobility of lead in the environment and/or reducing the volume of the contaminated media. Treatment technologies for lead focus on the chemical or physical immobilization of lead within the soil matrix or the separation of lead from the soil matrix. These general categories of treatment technologies are discussed below. The purpose of this chapter is to identify technologies that will be used to develop remedial alternatives in the subsequent chapter. Technologies that are inappropriate for use at the Dutch Boy Site are not evaluated further.

Technologies will be screened in accordance with the Administrative Order for the Site (USEPA 1996b), which states in section V.3.d "...develop and submit a Risk Management Plan to reduce the risks associated with the lead-contaminated soils... The plan should consider various alternatives to reduce the risks, compare cost and protectiveness of each alternative, and recommend an alternative to be implemented that is cost-effective and protective of human health and the environment."

A. Containment Technologies

The objective of a containment strategy at the Dutch Boy Site would be to break the direct contact pathway between contaminated soil and potential receptors. The containment alternatives for the Site range from a multi-layer cap system (i.e., a RCRA-quality cap) to a simple compacted soil cover.

In order for a cap or cover system to be effective, it should be continuous over the entire Site. Placing a series of caps or covers over noncontiguous areas of contamination within a relatively small site like Dutch Boy would reduce the overall effectiveness of the system and generate potentially significant maintenance problems. A Site-wide soil cover would provide adequate containment and would prevent direct exposure to the lead-impacted soils.

Installation of an effective cover system also requires preparation of the existing Site surface. Cover stability at the Dutch Boy Site would require ensuring proper drainage to prevent cover erosion and degradation. Cover systems also require periodic monitoring and maintenance to ensure the protectiveness and durability of the remedy.

It should be noted that much of the Site is already covered, by the existing concrete pavement and structures. Under these circumstances, a concrete or asphalt cap is a reasonable containment option. However, given the differences in grade between the paved and unpaved areas, a cover constituting several feet of soil is adequately protective and more economical than concrete or asphalt caps. Thus, a soil cover was selected as the containment technology for further evaluation.

B. Immobilization Technologies

Immobilization technologies are the most commonly used form of treatment prior to disposal. The most common method of immobilization is stabilization/solidification (S/S), which physically binds the soil matrix together more firmly. This can be done *ex situ* or *in situ* and is accomplished by mixing the lead-contaminated soil with a binding reagent to hold together more firmly the soil matrix and the lead compounds or particles. The S/S technique has been used widely at many lead-contaminated Sites, with a variety of binding agents and is the preferred technology for treatment prior to off-Site disposal (PDC 1998; Heritage 1998). With *ex situ* S/S, soil is excavated and mixed with the reagent in a pug mill, then replaced in the subsurface or disposed in a secure chemical landfill. *In situ* S/S relies on injecting the binding agent directly into the subsurface using jets, augers, backhoes, draglines, or other soil mixing equipment. The primary challenge with *in situ* S/S is achieving an acceptable degree of mixing between the contaminated soil and reagent in the subsurface and verifying the stability of the resultant mixture. *Ex situ* S/S produces much better mixing and long term stability.

Subsurface access at the Site is heavily obstructed and most of the Site is covered with reinforced concrete; below the concrete are numerous utility lines from public services and from Site operations. No records of the locations for many of these structures exist. Several borings had to be moved during the EOC sampling; subsurface access by the narrow-diameter, smooth-bore direct-push probe was refused. This, large-scale tilling or *in situ* mixing equipment is much less likely to reach the subsurface of the Site. In general, *in situ* S/S has many more uncertainties with respect to the complete mixing and immobilization of contaminants. Consequently, *ex situ* S/S is preferred over *in situ* S/S as an immobilization technology for this Site.

The addition of binding agents to the soil, whether treated *ex situ* or *in situ*, will result in a larger volume of material than that which was excavated initially. Volume expansion can range from 10% to 50% depending on the reagent used for stabilization. This must be accounted for during cost estimating. Typical costs for S/S are on the order of $100 per ton of soil treated (USEPA 1994a, 1994b, 1997; PDC 1998; Heritage 1998).

Any hydrocarbon contamination co-located in the lead-contaminated soil would be immobilized with the same reagents. Since the levels of hydrocarbons are not very high, additional treatment beyond S/S would not be required. The reagents used for S/S are unlikely to present potentially adverse chemical reactions with the hydrocarbons.

Another method for immobilizing lead on soil is vitrification. As with S/S, this can be done *ex situ* or *in situ*. Vitrification uses energy (electrical or heat) to melt and convert the soil matrix and contaminants to a glass-like solid substance. Once converted to a glass-like solid, the soil and contaminants are typically very stable and exhibit very low levels of contaminant leaching. The stability of the vitrified soil depends on the chemistry of the soil; additional compounds may be required to ensure the desired stability after the melting process. Another advantage of vitrification is that any organic compounds present in the contaminated soil would be destroyed through pyrolysis. Vitrification, though, is a very energy-intensive and therefore expensive process. Because of this, vitrification has been used primarily for solidifying radioactive wastes. Typical vitrification costs range from $400 to $870 per cubic yard and higher (USEPA 1994a, 1994b, 1997).

Both S/S and vitrification can convert soil and lead contamination to a highly immobile, stable form. Vitrification produces a more stable end product than S/S, but is considerably more expensive. Since lead is generally nonreactive and insoluble, the incremental increase in effectiveness at immobilizing lead offered by vitrification is not worth the additional costs. S/S is equally acceptable at immobilizing lead and is sufficiently protective of human health and the environment. Therefore, only the lower cost S/S will be addressed in evaluating remedial scenarios.

C. Separation Technologies

Another general treatment strategy for lead-contaminated soil is the removal or separation of lead from the soil matrix, leaving clean soil. This can be done *in situ* or *ex situ*. *Ex situ* methods involve excavation of soil and washing the soil with water or reagents. Water washing generally physically separates the fine fraction of soils, which usually contains most of the lead. Two waste streams result: (1) a concentrated lead-contaminated aqueous liquid or slurry with a high percent solids, and (2) relatively clean soil. The clean soil may be placed back at the Site, but the water-based effluent from the washing process requires appropriate disposal. The unit cost for disposing of lead-contaminated liquids is often higher than disposal for the original contaminated soil, although this may be offset by the smaller volume.

Chemical solvents can also be used to isolate and solubilize just the lead with selective leaching, removing it from the soil matrix. This results in a liquid chemical waste enriched in lead that requires special disposal and clean soil. Soil washing/separation has been done at many Sites with lead-contaminated soil, including the Ewan Property, N.J.; Zanesville Well Field, OH; and the Twin Cities Army Ammunition Plant, MN. Soil washing costs range from $60 to $245 per cubic yard. This does not include disposal of the contaminated effluent, which generally costs approximately $300 per 55-gallon drum (USEPA 1994, 1994b, 1997). The amount of waste effluent generated will depend on the washing process, determined in pilot tests, and the reagents used. Because of the high costs of disposing liquid waste effluent, soil washing processes are not considered further.

In situ methods use liquid-based flushing of the contaminant from the soil with capture of the contaminant-enriched flushing agent. Soil flushing of lead-contaminated soil has reportedly only been done once, at the Lipari Landfill, N.J. The Lipari flushing system required extraction wells below the zone of contamination. Because *in situ* flushing has not been widely used for inorganics, it is not appropriate for the Dutch Boy Site.

Another *in situ* flushing technology is electrokinetics. Electrokinetics provides *in situ* selective removal of lead and other ionic compounds from saturated soils. Electrokinetics uses electrodes installed in the soil to induce an electrical field in the subsurface. A low pH acid front is generated in the pore water at the negatively charged electrode. This acid front migrates across the subsurface to the opposite, positively charged electrode. Metallic and other compounds are dissolved into the low pH water. Dissolved ions then migrate through the water, under the electric potential gradient to the electrode that carries the opposite charge of the ion. Lead is generally present in soils as positively charged (cationic) oxide compounds, so it would migrate to the negatively charged electrode. Once the lead has been flushed from the soil, the electric current is shut off, the subsurface conditions return to normal, and the metals precipitate out in a much smaller volume of contaminated soil, which can then be excavated. Refinements on this technology include use of electrodes installed into wells; the contaminants migrate into the wells and can be pumped out.

Since the migration of the contaminants occurs in the dissolved phase, electrokinetics is really only applicable in well-saturated soils. Dry soils may require additional water to be added to the system. Given the extensive impermeable pavement at this Site, soil saturation would be difficult to achieve. Electrokinetics has been used on lead-contaminated soils, primarily in pilot-test scenarios. Although electrokinetics has been more widely used in Europe, it is not yet commonly used in the U.S. Because of the lack of maturation and use in the U.S. and the requirement for well-saturated soils, electrokinetics is not appropriate for use at the Dutch Boy Site.

D. Excavation/Disposal

Excavation removes contaminants above the given cleanup level (for the Dutch Boy Site, lead above 1400 ppm). Excavated areas are then backfilled. The excavated material is treated, as necessary, and is transported to an appropriate landfill for proper disposal.

E. Summary

Several proven technologies exist to mitigate and manage the risks posed by soil at the Dutch Boy Site, including containment, excavation/disposal, immobilization, and separation. Technologies such as soil washing, chemical extraction, electrokinetics, and vitrification are all technologically immature, generate large secondary waste streams, and/or are not cost effective. Therefore, the most feasible technologies for the Dutch Boy Site are containment using a soil cover, *ex situ* stabilization/solidification, and excavation/disposal. These technologies are well proven, appropriate for Site conditions, and are protective of human health and the environment.

VI. DESCRIPTION OF REMEDIAL SCENARIOS

The remedial scenarios available for the Dutch Boy Site include various combinations of excavation, treatment, disposal, and containment. Unit cost and technology performance data are taken from a variety of sources including vendor quotes, R.S. Means Co., 1998, *Environmental Remediation Cost Data - Assemblies*; USEPA 1994a, *Remediation Technology Screening Matrix*; USEPA 1994b, *Innovative Site Remediation Technology: Solidification/Stabilization, Volume 4*; and USEPA 1997, *Engineering Bulletin: Technology Alternatives for the Remediation of Soils Contaminated with As, Cd, Cr, Hg, and Pb.*

A. Miscellaneous Materials

1. Debris Pile

The Debris Pile on Site presents physical hazards in addition to risks from the asbestos-containing material (ACM) discovered in the EOC survey. The most feasible remedy for the Debris Pile is removal and disposal at an appropriate off-Site landfill. Given the relatively low levels of asbestos, disposal in a Subtitle D landfill would be feasible. At a unit cost of approximately $20 per cubic yard, removal and disposal of the Debris Pile is estimated to cost approximately $16,000.

2. Underground Storage Tanks

There are nine USTs at the Site, with a total capacity of approximately 150,000 gallons. These USTs are no longer in service, and their original contents appear to have been removed. The available information indicates that most of the tanks contained linseed oil, which is not a regulated substance. Two of the small tanks likely contained regulated substances, but may not be subject to closure requirements because of grandfather provisions in the regulations. However, for purposes of costing the alternatives it was assumed that all of the tanks require removal. Based on the estimated capacity of 150,000 gallons and a removal cost of $1.25 per gallon, the total cost for cleaning, excavating, and disposing of the tanks, plus backfilling the excavation zones, is estimated to be approximately $187,500.

B. Lead Affected Soils

Based on the technologies evaluated in the preceding chapter, four alternatives were considered that meet the objective of the Administrative Order of being adequately protective of human health and the environment. These alternatives are as follows:

1. Containment of all soil with lead concentrations greater than 1,400 mg/kg;
2. Removal of principal threat wastes and containment of all soil with lead concentrations greater than 1,400 mg/kg;
3. Removal of the top two feet of soil in the unpaved areas and principal threat wastes, followed by containment of all remaining soil with lead concentrations greater than 1,400 mg/kg; and
4. Removal of all soil with lead concentrations greater than 1,400 mg/kg.

These are discussed in detail below.

1. Alternative 1 - On-Site Containment

Alternative 1 would entail placing compacted fill over the unpaved areas to an average final depth of approximately five feet. This would raise the unpaved areas to a level approximately two feet above the existing paved areas, which would provide effective drainage and erosion control.

Fill will require periodic maintenance, revegetation, and verification sampling to ensure that contaminated soil is not exposed at the surface. Placing and compacting clean fill, at approximately $20 per cubic yard, would cost about $216,000 for the approximately 4,621 square yards comprising the unpaved areas of the Site. Annual operations and maintenance costs are likely to be on the order of $5,000 to $10,000 per year. Assuming a 5% discount rate and $7,500 per year average maintenance costs, the present worth operations and maintenance cost over 30 years would be $115,000.

The USTs and Debris Pile would be closed as described in Section A above, for a cost of approximately $203,000.

The Site-wide total cost for covering the lead-impacted soil, and Debris Pile and UST removal, plus design, management, and contingency would be $744,000. Table 3 summarizes the major cost components.

2. **Excavation, Treatment, and Off-Site Disposal of Top two feet of Principal Threat Soil and Containment of Remaining Unpaved Area Soils**

Alternative 2 comprises removal of the top two feet of lead-contaminated soils in the unpaved area in the locations where principal threat wastes are found (in the vicinity of boreholes SS06 through SS12) followed by backfilling and covering the entire unpaved area as described in Alternative 1 above. The principal threat waste area comprises an area of approximately 963 square yards. This yields a total volume of 640 cubic yards for treatment with S/S, transportation, and secure landfill disposal.

The remainder of the soil in the unpaved area exceeding the 1,400 mg/kg threshold would be contained by a soil cover, as described above. The USTs and Debris Pile would be addressed as described in Section A above, for a cost of approximately $203,000.

The Site-wide total cost for covering the lead-impacted soil, and Debris Pile and UST removal, including design, management, and contingency is estimated to be $940,000. Table 4 summarizes the major cost components.

3. **Alternative 3 - Excavation, Treatment, and Removal of the Top Two Feet of Contaminated Soil in the Unpaved Areas**

This alternative considers the excavation, treatment, and disposal of the soil in the top two feet of the unpaved areas, nearly all of which exceed the 1,400 mg/kg threshold. This soil horizon is where the majority of the lead in the unpaved areas is located. Excavated soil would be treated and disposed offsite. Excavation, treatment and disposal costs are estimated to be $656,000. The USTs and Debris Pile would be addressed as described in Section A above, for a cost of approximately $203,000.

The Site-wide total cost for this alternative would be $1,197,000, including design, management, and contingency. Table 5 summarizes the major cost components.

4. **Alternative 4 - Excavate All Unpaved Area Soils With Greater Than 1,400 mg/kg Lead, Treat, Dispose Off-Site**

This alternative considers excavation, treatment, and disposal of all the soil in the unpaved areas with lead contamination greater than 1,400 mg/kg. Excavated soil from the unpaved areas would be treated and disposed offsite. Excavated soil would be replaced with compacted clean fill to original grade. The cost for removal, treatment, and disposal of the lead-impacted soil would be $967,000.

The USTs and Debris Pile would be addressed as described in Section A above, for a cost of approximately $203,000.

The Site-wide total cost for this alternative, including design, management, and contingencies, is estimated to be $1,630,000. Table 6 summarizes the major cost components.

VII. EVALUATION OF REMEDIAL SCENARIOS

A. Comparison of Alternatives

The best remedial alternative is that which protects human health and the environment over the long term. The evaluation of alternatives is weighted primarily on protectiveness and cost, in accordance with the Order. All the alternatives that passed through the screening process are protective of human health and the environment; however, only Alternative 4 leaves no lead in the unpaved area above the cleanup level.

Alternative 1 requires that all soil containing lead be covered with several feet of compacted, vegetated soil. This alternative includes provisions for the continued maintenance of this cover as well as periodic sampling and analysis to ensure that the protectiveness is adequate. This alternative is protective in that exposure to the contaminated soil is interrupted. Since the lead-contaminated soils are not exposed at the surface, but are covered with several feet of clean soil, no exposure is permitted. However, isolated hot spots of high concentrations of lead, above the principal threat criterion, remain, which will require that restrictions be placed on intrusive activities in the hot spot areas. The Debris Pile and USTs are removed, if required by applicable regulations, under this and all other alternatives.

Alternative 2 is similar to Alternative 1, but removes soil with high concentrations of lead. This approach is consistent with the recommendation in Section III.16 of the Administrative Order, which recommended that "...any hot spots which are significantly higher than the 1,400 ppm be remediated even if, when averaged, they contribute to an acceptable range of risk." This mitigates any potential future exposures and risks associated with the principal threat wastes, which are treated with S/S and disposed in an appropriate RCRA Subtitle C secure landfill. This alternative also includes provisions for the continued maintenance of the soil cover as well as periodic sampling and analysis to ensure that the protectiveness is adequate. This alternative is protective in that exposure to the contaminated soil is interrupted. Since the lead-contaminated soils are not exposed at the surface, but are covered with several feet of clean soil, no exposure is permitted. Since principal threat wastes are removed, Alternative 2 affords an added level of protection in the long-term, although short term implementation risks will have to be controlled.

Alternative 3 removes the top two feet of soil in the unpaved area that contains soil with lead concentrations greater than the 1,400 mg/kg threshold established in the USEPA risk assessment. All excavated soil is removed from the Site, treated, and disposed in a RCRA Subtitle C secure landfill. The excavation zone is backfilled with compacted, clean soil. This clean fill acts as a cover for soil below the two foot horizon that contains lead at concentrations above the 1,400 mg/kg threshold. Removal of the top two feet of soil will address exposed soil across the Site, leaving residual lead at depths that are not readily accessible. The cost of this alternative is approximately 30% greater than that of Alternative 2.

Alternative 4 entails complete removal of all lead-contaminated soil in the unpaved area with concentrations greater than 1,400 mg/kg. This strategy removes all long-term risk under an industrial reuse scenario and minimizes future operations and maintenance burdens. This alternative also costs the most, but is the only alternative that leaves no lead above the cleanup level in the unpaved area of the Site.

B. Recommended Alternative

The recommended alternative for the Dutch Boy Site is Alternative 4. This alternative provides for excavation and proper disposal of all soils in the unpaved areas that exceed the applicable on-site soil cleanup level of 1400 ppm lead. This alternative eliminates the potential for inhalation and ingestion of unacceptable levels of lead in unpaved area soils on site. This alternative also includes a provision for repair of and O&M for, on-site paved surfaces to ensure that exposure does not occur to soil with lead concentrations exceeding the cleanup level, and that contaminated soil generated from any intrusive future activities is properly managed. Also as part of this alternative, the USTs would be removed, if required by applicable regulations, and the Debris Pile would be removed from the Site and disposed appropriately.

In conclusion, this remedy is adequately protective of public health and the environment, meets the statutory criteria established under the NCP, is consistent with the Administrative Order, and is a cost effective remedy.

C. Implementation

The schedule for implementation of the Recommended Alternative is outlined in Figure ES-1. The design documents (60% and 100%) for Alternative 4 will include RD/RA Plans, Specifications, QAPP, HSP, Cost Estimate, and Project Schedule.

VIII. REFERENCES

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TABLES

TABLE 1
Summary of On-Site Lead Results
Dutch Boy Site: Chicago, Illinois

Sample Location	Base of Fill (ft bgs)	Depth (ft bgs)	Lead (mg/kg)
SS01	2.7	0.0 - 0.2	330.
		0.2 - 1	950.
		1 - 2	1,970.
		2 - 3	131.
		3 - 4	4.5
		4 - 5	14.6
		5 - 6	9.2
		6 - 7	8.5
		7 - 8	5.5
SS02	2.0	0.0 - 0.2	2,300.
		0.2 - 1	1,130.
		1 - 2	3,200/< 5,000
		2 - 3	6.7
		3 - 4	11.3
		4 - 5	13.7/20.4
		5 - 6	5.4
		6 - 7	32.
SS03	3.5	0.0 - 0.2	1,310.
		0.2 - 1	850.
		1 - 2	3,900.
		2 - 3	9.9
		3 - 4	12.5
		4 - 5	6.
		5 - 6	11.
		6 - 7	8.5
		7 - 8	8.8
		8 - 9	12.4
SS04	3.5	0.0 - 0.2	3,500.
		0.2 - 1	3,500.
		2 - 3	780.
		3 - 4	18.6
		4 - 5	7.5
		5 - 6	9.1
SS05	4.0	0.0 - 0.2	193.
		0.2 - 1	86.
		1 - 2	2,610.
		2 - 3	580.
		3 - 4	13.5
		4 - 5	13.8
		5 - 6	7.5
		6 - 7	186.
		7 - 8	17.7
		8 - 9	110.

Sample Location	Base of Fill (ft bgs)	Depth (ft bgs)	Lead (mg/kg)
SS06	4.0	0.0 - 0.2	4,000.
		0.2 - 1	16,300.
		1 - 2	460.
		2 - 3	53,100.
		3 - 4	1,580/1,370
		4 - 5	46.
		5 - 6	8.
		6 - 7	15.2
		7 - 8	8.1/7.6
		8 - 9	8.5
SS07	3.6	0.0 - 0.2	1,730.
		0.2 - 1	3,500.
		1 - 2	17,600.
		2 - 3	10,000.
		3 - 4	7.2
		4 - 5	17.5
		5 - 6	5.6
		6 - 7	11.7/9.9
		7 - 8	9.2
SS08	3.8	0.0 - 0.2	5,800/6,300
		0.2 - 1	30,300.
		1 - 2	60,000.
		2 - 3	238.
		3 - 4	9,100.
		4 - 5	49.
		5 - 6	8.6/29.1
		6 - 7	43,000.
		7 - 8	79.
		8 - 9	29/22.3
SS09	4.0	0.0 - 0.2	7,800.
		0.2 - 1	950.
		1 - 2	94,000.
		2 - 3	63,000.
		3 - 4	68,000.
		4 - 5	25,000/13,200
		5 - 6	600.
		6 - 7	25.
		7 - 8	8.6
		8 - 9	10.3
		9 - 10	11.
SS10	4.0	0.0 - 0.2	17,200.
		0.2 - 1	238,000/299,000
		1 - 2	14,200.

Sample Location	Base of Fill (ft bgs)	Depth (ft bgs)	Lead (mg/kg)
SS10		2 - 3	730.
		3 - 4	2,100.
		4 - 5	2,040.
		5 - 6	490.
		6 - 7	570.
		7 - 8	15.4
		8 - 9	10.5
SS11	3.5	0.0 - 0.2	5,400.
		0.2 - 1	3,200.
		1 - 2	72,000.
		2 - 3	9,000.
		3 - 4	220.
		4 - 5	57.
		5 - 6	8,600.
		6 - 7	153/157
		7 - 8	14.2
SS12	4.0	0.0 - 0.2	9,800/11,600
		0.2 - 1	4,300/5,400
		1 - 2	58,000.
		2 - 3	26,900.
		3 - 4	67,000.
		4 - 5	7,300.
		5 - 6	56,000.
		6 - 7	1,740.
		7 - 8	104.
		8 - 9	22.3
SS13	4.3	0.0 - 0.2	7,700.
		0.2 - 1	6,300.
		1 - 2	7,500.
		2 - 3	2,200.
		3 - 4	3,100.
		4 - 5	850.
		5 - 6	58.
		6 - 7	5,100.
		7 - 8	156.
		8 - 9	12.8
SS14	NE	0.0 - 0.2	4,900.
		0.2 - 1	4,510.
		1 - 2	333.
SS15	4.2	0.0 - 0.2	7,100.
		0.2 - 1	20,000.
		1 - 2	12,300.
		2 - 3	23.9

Sample Location	Base of Fill (ft bgs)	Depth (ft bgs)	Lead (mg/kg)
SS15		3 - 4	121.
		4 - 5	13.8
		5 - 6	16.7
		6 - 7	33.
		7 - 8	10.1
		8 - 9	10.5
SS16	3.0	0.0 - 0.2	10,600.
		0.2 - 1	10,600.
		1 - 2	3,940.
		2 - 3	393.
		3 - 4	3.1
		4 - 5	172.
SS17	4.0	0.0 - 0.2	6,100.
		0.2 - 1	16,900/16,400
		1 - 2	9,700.
		2 - 3	5,400.
		3 - 4	460.
		4 - 5	25.3
		5 - 6	10.1
		6 - 7	61.
		7 - 8	8.3
		8 - 9	5.6
SS18	4.0	0.0 - 0.2	8,400.
		0.2 - 1	7,900.
		1 - 2	5,800.
		2 - 3	2,320.
		3 - 4	1,630.
		4 - 5	289/340
		5 - 6	9.8
		6 - 7	10.3
		7 - 8	7.3
		8 - 9	7.6
SS19	2.5	0.0 - 0.2	7,300.
		0.0 - 0.2	43/44
		0.2 - 1.0	51.
SS20	2.2	0.0 - 0.2	1,130.
		0.2 - 1.0	98.
SS21	2.6	0.0 - 0.2	61.
		0.2 - 1.0	1,370.
SS22	3.3	0.0 - 0.2	54.
		0.2 - 1	20.7
		1 - 2	410.
		3 - 4	92.

TABLE 1
Summary of On-Site Lead Results
Dutch Boy Site: Chicago, Illinois

Sample Location	Base of Fill (ft bgs)	Depth (ft bgs)	Lead (mg/kg)
SS22		4 - 5	11.7
		5 - 6	10.
SS23	2.7	0.0 - 0.2	123.
		0.2 - 1.0	250/260
SS24	2.7	0.0 - 0.2	410.
		0.2 - 1.0	260.
SS25	2.6	0.0 - 0.2	1,740.
		0.2 - 1.0	770.
SS26	2.8	0.0 - 0.2	400.
		0.2 - 1.0	5,900.
		1 - 2	1,470.
SS27	1.9	0.0 - 0.2	16,300.
		0.2 - 1.0	480.
SS28	NE	0.0 - 0.2	8,300.
		0.2 - 1.0	6,700.
SS29[1]	2.9	0.0 - 0.2	74.
		0.2 - 1.0	44/38
SS30[1]	4.6	0.0 - 0.2	310.
		0.2 - 1	1,310/1,390
SS31	5.1	0.0 - 0.2	7,100/7,400
		1 - 2	2,070.
		2 - 3	790.
		3 - 4	650.
		4 - 5	4,000.
		5 - 6	490/370
SS32	2.3	0.0 - 0.2	1,400.
		0.2 - 1	63.
		1 - 2	45/55
SS33	2.9	0.0 - 0.2	7,500.
		0.2 - 1	9,100.
		1 - 2	31,800.
		2 - 3	147.
SS34	4.0	0.0 - 0.2	8,400.
		0.2 - 1	1,440.
		1 - 2	52.
		2 - 3	185.
		3 - 4	106.
SS35[1]	NE	0.0 - 0.2	410.
		0.2 - 1	17.
SS36	2.5	0.0 - 0.2	6,500.
		0.2 - 1	1,320.
SS37	3.0	0.0 - 0.2	6,200.
		0.2 - 1	5,800.
SS37		1 - 2	1,910.
		2 - 3	6.6/5.6
		3 - 4	4.6/4.6
SS38	3.7	0.0 - 0.2	6,100.
		0.2 - 1	3,200/2,500
		1 - 2	4,500.
		2 - 3	1,230.
		3 - 4	6.
SS39[1]	4.3	0.0 - 0.2	460.
		0.2 - 1	55.
SS40	2.7	0.0 - 0.2	18,300.
		0.2 - 1	2,130.
		1 - 2	228.
		2 - 3	5.5
SS41	3.4	0.0 - 0.2	5,900.
		0.2 - 1	4,800.
		1 - 2	750.
		2 - 3	430.
		3 - 4	10.6
SS42	2.7	0.0 - 0.2	1,060.
		0.2 - 1	11,300.
		1 - 2	1,470/1,700
		2 - 3	5.7
SS43[1]	4.1	0.0 - 0.2	25.1
		0.2 - 1	13.2
SS44[1]	NE	0.0 - 0.2	14.3
		0.2 - 1	22.3/19.6
SS45	2.9	0.0 - 0.2	1,900.
		0.2 - 1	4,100.
		1 - 2	2,900.
		2 - 3	420.
SS46[1]	N/A	N/A	N/A
SS47	1.8	0.0 - 0.2	18.1
		0.2 - 1	880/700
SS48	2.6	0.0 - 0.2	540.
		0.2 - 1	1,720.
		1 - 2	1,210/1,810
		2 - 3	7.3
SS49	2.6	0.0 - 0.2	800/590
		0.2 - 1	1,380.
		1 - 2	1,220.
		2 - 3	6.2/12.9
SS50	2.6	0.0 - 0.2	730.
SS50		0.2 - 1	6,700.
		1 - 2	1,860.
		2 - 3	8.4
SS51	2.7	0.0 - 0.2	880/780
		0.2 - 1	2,820.
		1 - 2	7,600.
		2 - 3	530.
SS52[1]	4.3	0.0 - 0.2	9.9
		0.2 - 1	41/42
SS53[1]	6.7	0.0 - 0.2	12.3
		0.2 - 1	21.
SS54[1]	5.6	0.0 - 0.2	11.3
		0.2 - 1	740.
SS55	2.2	0.0 - 0.2	17,300.
		0.2 - 1	2,500.
		1 - 2	55.
SS56	2.4	0.0 - 0.2	19.7
		0.2 - 1	1,090.
SS57	N/A	0.0 - 0.2	25,000.
		2 - 3	26,900.
		3 - 4	67,000.
		4 - 5	7,300.
		5 - 6	56,000.
		6 - 7	1,740.
		7 - 8	104.
		8 - 9	22.3

Table 2
Summary of Data from Unpaved Area Boreholes
Dutch Boy Site: Chicago, Illinois

Unpaved Area Borehole	Area Represented (square ft.)	Maximum Depth (feet)	Volume of Soil 0-2 feet (cubic yds)	Volume of Soil > 2 feet (cubic yds)	Total Volume (cubic yds)	Average Concentration 0-2 feet (mg/kg)
SS01	2,455	2	182		182	1,398
SS02	1,544	2	114		114	2,282
SS03	1,792	2	133		133	2,421
SS04	1,165	2	86		86	2,140
SS05	1,619	2	120		120	1,359
SS06	1,231	4	91	91	182	7,150
SS07	1,216	3	90	45	135	10,373
SS08	1,195	7	89	221	310	42,725
SS09	1,296	5	96	144	240	48,160
SS10	1,197	5	89	133	222	116,220
SS11	1,318	6	98	195	293	37,820
SS12	1,212	7	90	224	314	32,010
SS13	1,244	7	92	230	323	7,040
SS14	1,056	2	78		78	2,461
SS15	1,345	2	100		100	14,860
SS16	1,073	2	79		79	7,270
SS17	2,145	3	159	79	238	12,120
SS18	1,490	4	110	110	221	6,900
SS31	871	5	65		65	1,760
SS32	567	2	42		42	190
SS33	1,478	2	109		109	20,290
SS34	952	2	71		71	1,442
SS37	929	2	69		69	3,895
SS38	1,541	2	114		114	4,000
SS40	1,426	2	106		106	2,796
SS41	1,549	2	115		115	2,885
SS42	1,530	2	113		113	5,419
SS45	1,501	2	111		111	3,280
SS48	834	2	62		62	1,497
SS49	1,249	2	93		93	1,232
SS50	718	2	53		53	3,683
SS51	854	2	63		63	5,011
Totals	41,592		3,081	1,474	4,555	

Table 3
Cost Summary for Alternative 1
Cover All Unpaved Area Soils
Remove and Close USTs and Debris Pile

Alternative 1	Unit Cost ($/unit)	Units		Notes	Cost
Soil Cover (includes delivery, placement, compaction, vegetation)	$20	10,783	(yd3)	1,2	$215,662
Remove and close USTs	$1.25	150,000	(gal)	1	$187,500
Remove and dispose Debris Pile	$20	800	(yd3)	1	$16,000
Maintenance	$7,500	30	(yrs)	3	$115,293
Engineering Design	10%				$53,446
Project Management	10%				$58,790
Contingency	15%				$97,004
TOTAL					**$743,695**

Notes:

1. Cost estimate from RS Means Co. (1998)
2. Volume estimate assumes a depth of 7 feet to cover unpaved areas; 3 feet to bring level with concrete pavement and 4 feet of cover above pavement, with a 3:1 slope for drainage and settlement
3. Net present worth analysis using 30 year duration and 5% discount rate

Table 4
Cost Summary for Alternative 2
Excavate, Treat, and Off-Site Disposal of Two Feet of Soil in Principal Threat Area
Cover All Unpaved Area Soils
Remove and Close USTs and Debris Pile

Alternative 2	Unit Cost ($/unit)	Units		Notes	Total Cost
Excavate principal threat wastes	$5	642	(yd3)	1	$3,190
Transportation to Peoria, IL	$39	642	(yd3)	2	$25,032
Treat soil with solidification/stabilization	$68	642	(yd3)	2	$43,646
Disposal at PDC Subtitle C landfill	$68	802	(yd3)	2	$54,156
Soil Cover (includes delivery, placement, compaction, vegetation)	$20	11,425	(yd3)	1,2	$228,499
Remove and close USTs	$1.25	150,000	(gal)	1	$187,500
Remove and dispose Debris Pile	$20	800	(yd3)	1	$16,000
Maintenance Costs	$7,500	30	(yrs)	3	$115,293
Engineering Design	10%				$67,332
Project Management	10%				$74,065
Contingency	15%				$122,207
TOTAL					**$936,921**

Notes:

1. Cost estimate from RS Means Co. (1998)
2. Volume estimate assumes a depth of 7 feet to cover unpaved areas; 3 feet to bring level with concrete pavement and 4 feet of cover above pavement, with a 3:1 slope for drainage and settlement
3. Net present worth analysis using 30 year duration and 5% discount rate

Table 5
Cost Summary for Alternative 3
Excavate, Treat, and Off-Site Disposal of Top 2 feet Unpaved Area Soils
Remove and Close USTs and Debris Pile

Alternative 3	Unit Cost ($/unit)	Units		Notes	Total Cost
Excavate unpaved area soil down to 2 feet	$5	3,081	(yd3)	1	$15,313
Transportation to Peoria, IL	$39	3,081	(yd3)	2	$120,159
Treat soil with stabilization/solidification	$68	3,081	(yd3)	2	$209,508
Disposal at PDC RCRA Subtitle C landfill	$68	3,851	(yd3)	2,3	$261,885
Remove and Dispose USTs	$1.25	150,000	(gal)	1	$187,500
Remove and Dispose Debris Pile	$20	800	(yd3)	1	$16,000
Backfill and restore Site	$16	3,081	(yd3)	1	$49,296
Engineering Design	10%				$85,966
Project Management	10%				$94,563
Contingency	15%				$156,028
TOTAL	$322	3,081	(yd3)		**$1,196,218**

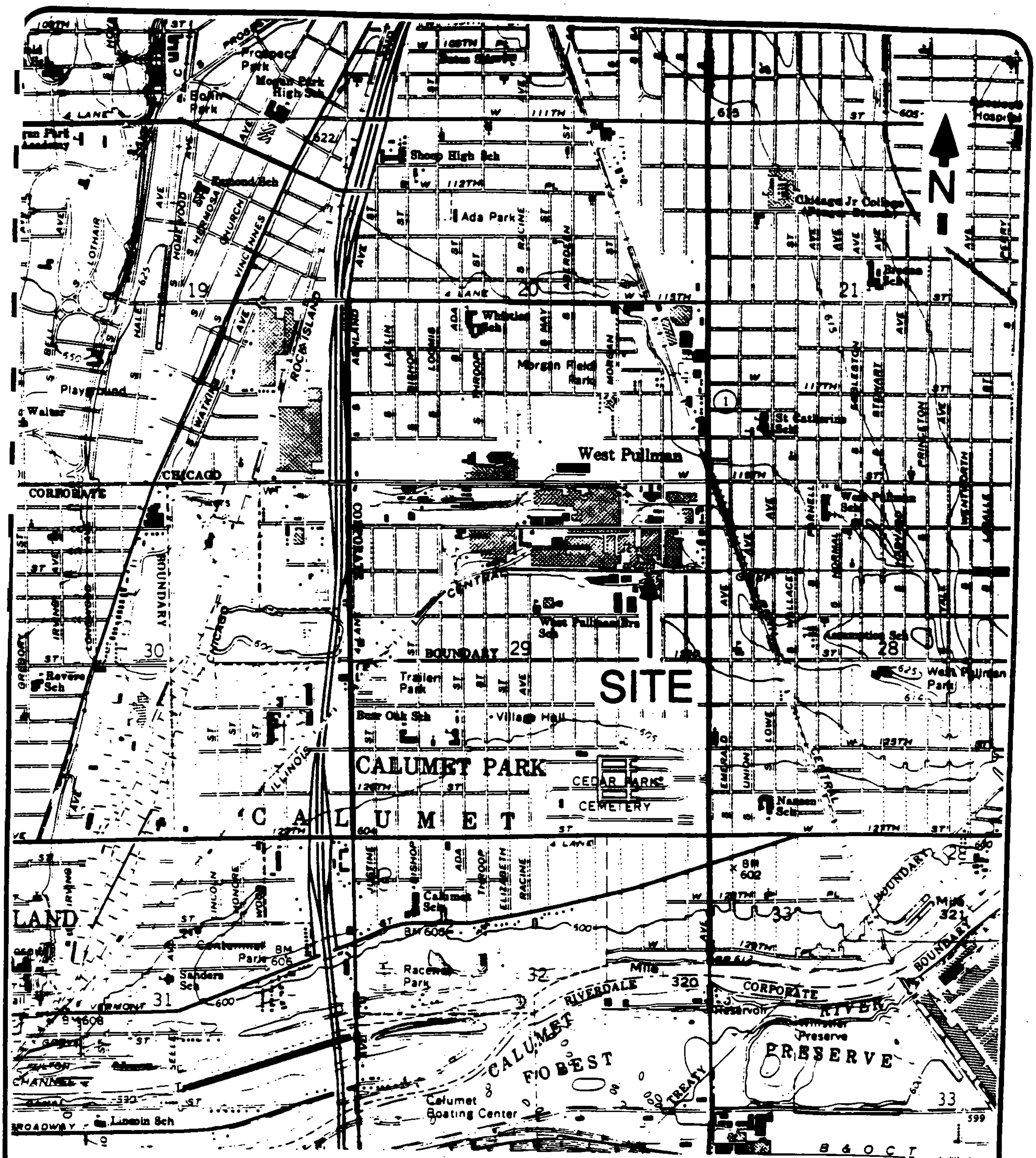
Notes:
Alternative 2
2. Cost estimate from Peoria Disposal Co. (1998)
3. Assumes a volume increase of 25% from S/S treatment and disposal at the PDC RCRA Subtitle C landfill

Table 6
Cost Summary for Alternative 4
Excavate, Treat, and Off-Site Disposal of All Unpaved Area Soils with Lead > 1,400 mg/kg
Remove and Close USTs and Debris Pile

	Unit Cost ($/unit)	Units		Notes	Total Cost
Excavate unpaved area soil down to 2 feet	$5	3,081	(yd3)	1	$15,313
Excavate unpaved area soil below 2 feet	$5	1,474	(yd3)	1	$7,326
Transportation to Peoria, IL	$39	4,555	(yd3)	2	$177,645
Treatment	$68	4,555	(yd3)	2	$309,740
Disposal at PDC Subtitle C landfill	$68	5,694	(yd3)	2,3	$384,328
Remove and close USTs	$1.25	150,000	(gal)	1	$187,500
Remove and dispose Debris Pile	$20	800	(yd3)		$16,000
Backfill and restore site	$16	4,555	(yd3)	1	$74,748
Engineering Design	10%				$117,260
Project Management	10%				$128,986
Contingency	15%				$212,827
TOTAL	$314	4,555	(yd3)		**$1,631,672**

Notes:
1. Cost estimate from RS Means Co. (1998)
2. Cost estimate from Peoria Disposal Co. (1998)
3. Assumes a volume increase of 25% from S/S treatment and disposal at the PDC RCRA Subtitle C landfill

FIGURES

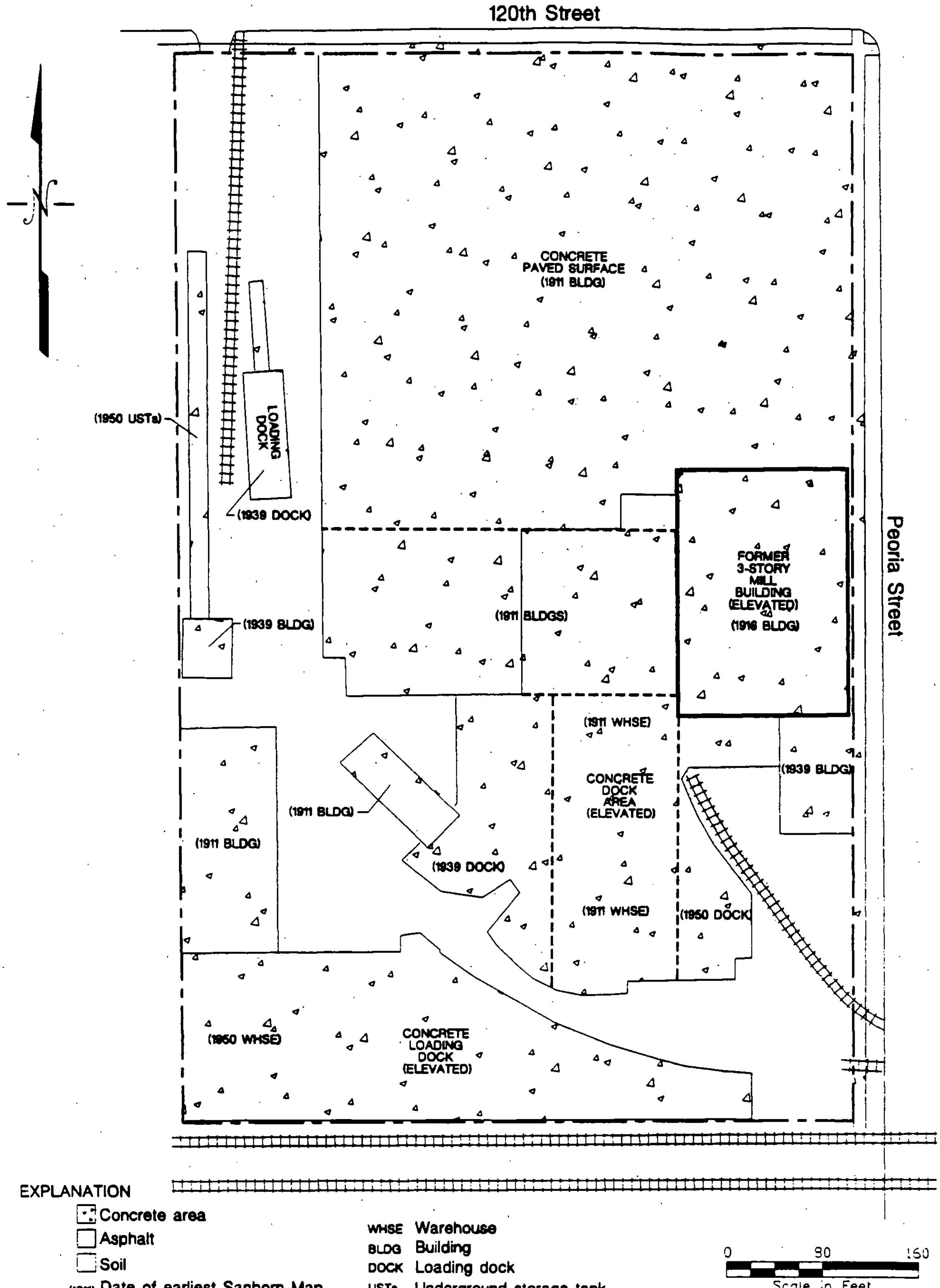


0 2000 4000

Scale in Feet

SOURCE: USGS 7.5 MINUTE (TOPOGRAPHIC) SERIES; BLUE ISLAND, ILLINOIS QUADRANGLE

ENVIRON A Division of APBI	SITE LOCATION MAP DUTCH BOY SITE CHICAGO, ILLINOIS	Figure 1



EXPLANATION

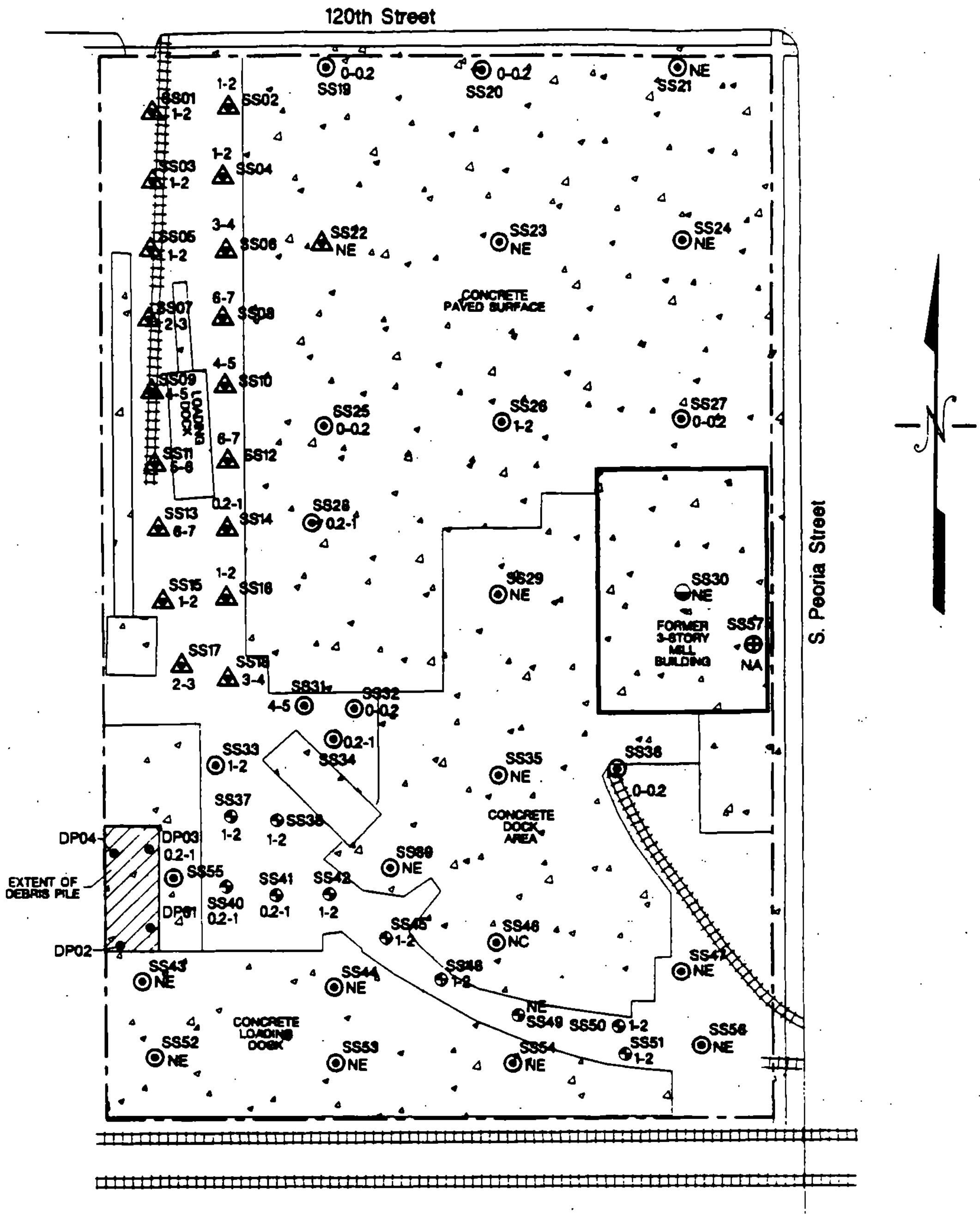
- Concrete area
- Asphalt
- Soil
- (1911) Date of earliest Sanborn Map showing construction or pavement in area

WHSE	Warehouse
BLDG	Building
DOCK	Loading dock
USTs	Underground storage tank

ENVIRON

SITE LAYOUT
DUTCH BOY SITE
CHICAGO, ILLINOIS

Figure 2



EXPLANATION

- Soil core to 5 feet below base of fill
- Soil core to base of fill
- Soil core to base of fill; includes asbestos analysis
- Debris sample
- Sediment sample
- Soil sample from below sub-basement

0.2-1 Maximum depth (in feet) at which lead was detected in soils >1,400 mg/Kg

NE: No exceedence of 1,400 mg/Kg detected

NC: No sample collected

0 100 200

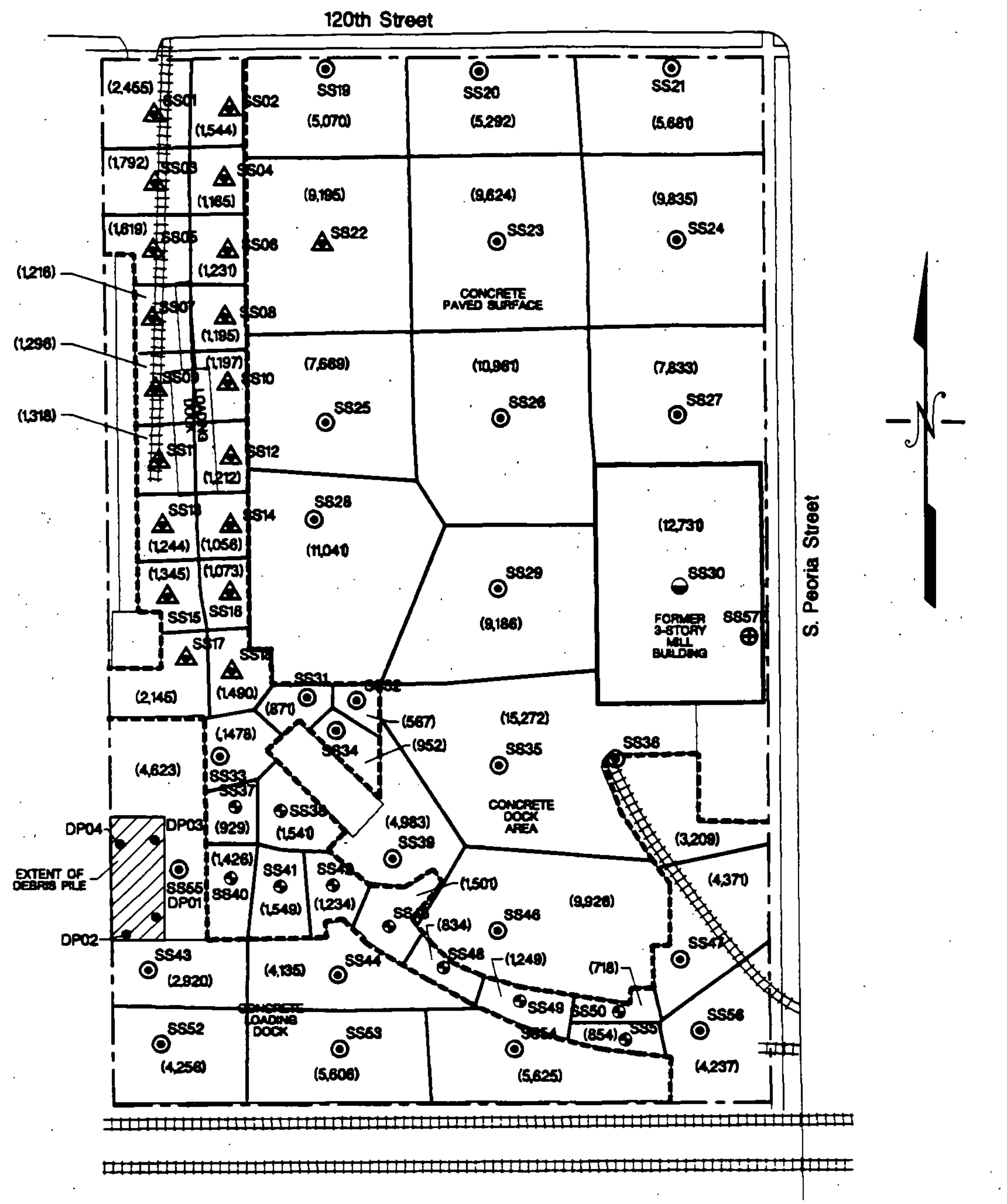
Scale in Feet

NOTE: Sampling intervals at each core location are detailed in report.

ENVIRON

MAXIMUM DEPTH (IN FEET) OF LEAD
DUTCH BOY SITE
CHICAGO, ILLINOIS

Figure 3



EXPLANATION

- Soil core to 5 feet below base of fill
- Soil core to base of fill
- Soil core to base of fill; includes asbestos analysis
- Debris sample
- Sediment sample
- Soil sample from below sub-basement

0.2-1 Maximum depth (in feet) at which lead was detected in soils >1400 mg/Kg

NE: No exceedence of 1,400 mg/Kg detected

NC: No sample collected

—— Boundary representing extent of contamination associated with specific boreholes

– – – – Boundary between paved and unpaved areas

(2,455) Area of polygon in square feet (ft^2)

c:\acad\014598a\4598AB30

NOTE: Sampling intervals at each core location are detailed in report.

ENVIRON

BOREHOLE-BASED AREAL EXTENT OF CONTAMINATION POLYGONS
DUTCH BOY SITE
CHICAGO, ILLINOIS

Figure 4